

POULTRY AND FOWLING AT THE ROMAN CASTELLUM VELSEN 1

W. Prummel

Biologisch-Archaeologisch Instituut, Groningen, Netherlands

ABSTRACT: A total of 3191 bones of domestic and wild birds from the Roman castellum Velsen 1, the Netherlands, c. 15-30 AD, have been identified. Domestic fowl was the most important bird species consumed. Peacock has been demonstrated by one bone. Over 30 wild bird species have been identified. Six possible types of fowling have been distinguished.

KEYWORDS: Velsen 1, the Netherlands, Roman, castellum, archaeozoology, bird remains, domestic fowl, peacock, fowling, wild ducks, wild geese, crane, black grouse, partridge, Charadriidae, Scolopacidae, wood pigeon, Turdidae, white-tailed eagle, Corvidae, fish-eating birds, scavenging birds.

1. INTRODUCTION

In the 1970s and 1980s the Dutch organisation of amateur archaeologists A.W.N. excavated parts of the harbour of the Roman castellum Velsen 1 (Vons, 1980; 1981; 1982; Morel & de Weerd, 1980; Morel, 1986) (fig. 1). The Institute for Prae- and Protohistory of the University of Amsterdam executed excavations in the castellum itself and supervised the A.W.N. excavations.

Velsen 1 was a small castellum situated on the former Oer-IJ, which was the most northern branch of the Rhine (Morel, 1986). Two periods of occupation and of building of fortifications are distinguished (Morel, 1980; 1981; 1982; 1983; 1987). Buildings were few in the castellum. Two long and narrow buildings have been found, that are interpreted as boat-houses (Morel, 1986). The castellum possessed at least three piers, that extended into the Oer-IJ.

The castellum was built c. 15 AD, and was occupied with an interruption until about 30 AD (Vons, 1980; 1981; 1982; Morel, 1986). The occupation coincided with the efforts of the Romans to conquer the areas between the Rhine and the Elbe (van Es, 1981; Morel, 1986: p. 202). Shortly after the building of Velsen 1 these schemes were abandoned. Around 40 AD the Roman army was present on the site Velsen 2, at a short distance from Velsen 1. This site was abandoned c. 47 AD, after the limes along the Rhine had been established (Morel, 1986: p. 210). The I.P.P. and the A.W.N. executed small excavations in Velsen 2.

The A.W.N. asked the archaeozoology department of the B.A.I. to study the bird and fish bones

from their excavations at Velsen 1 and 2 (Gordijn-Vons, 1977). A.T. Clason and the author identified the bird bones. D.C. Brinkhuizen is studying the fish bones. The fish and bird species that had been found in Velsen 1 and 2 until 1979 have been published in preliminary reports (Gordijn-Vons, 1977; Clason & Prummel, 1978; 1979; Clason et al., 1979). In the material studied after 1979 some additional bird species have been identified. This paper discusses the bird remains of Velsen 1 in more detail.

2. THE BIRD BONES OF VELSEN 1

The A.W.N. excavations in Velsen 1 were concentrated on the former bed of the Oer-IJ, between the three piers. Bird bones were preserved here extremely well. They have been collected in large quantities, partly by sieving, partly by carefully scraping the earth with a trowel. Nearly all bird bones are from waste that was thrown into the Oer-IJ.¹ The water will have moved the bones to some extent. Therefore few bones will have been found in situ, that is where they fell or were thrown into the water. For this reason all bird bones from the Oer-IJ are discussed together.

The A.W.N. carried out minor excavations in the castellum itself. Because of medieval erosion (Morel, 1986: p. 206) the preservation conditions in the castellum were poor. The habitation surface had disappeared. Some bird bones were collected in wells. Because their number is small they are discussed together with the bird bones from the Oer-IJ.

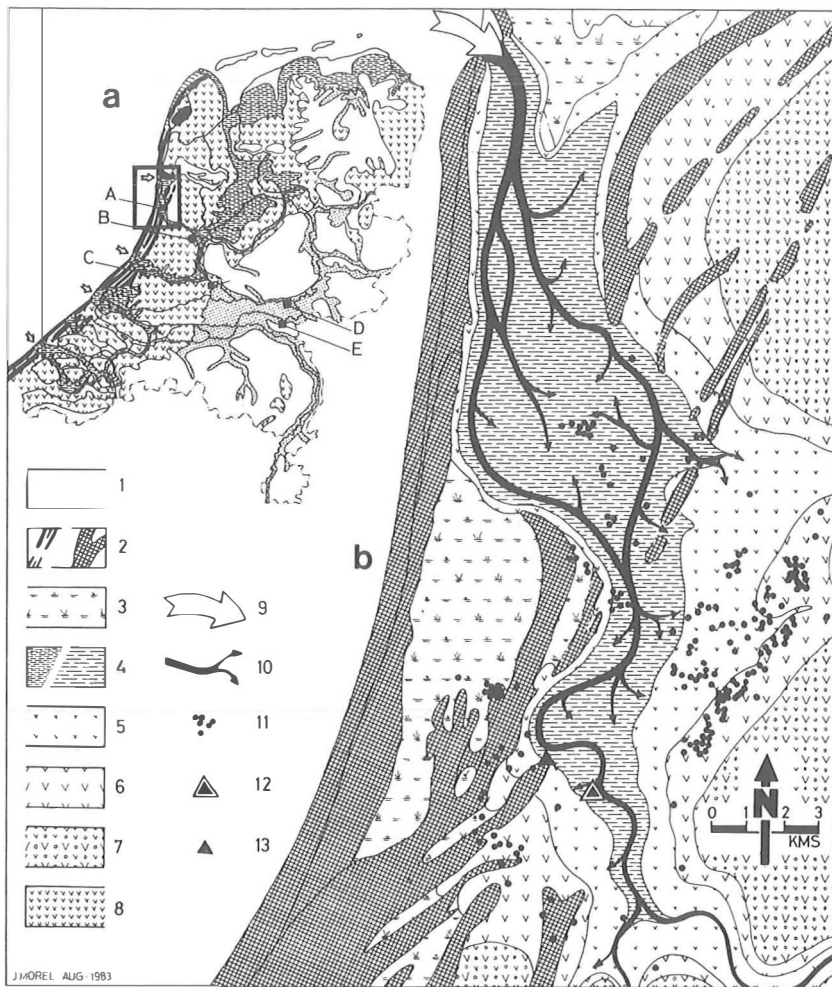


Fig. 1. Palaeogeographic maps of the Netherlands (a), and the surroundings of the Roman castellum Velsen 1 (b) in the first century AD (after Morel, 1986: fig. 1). Key: 1. Pleistocene sand; 2. coastal barriers, dunes, beaches; 3. emergent sandy estuarine deposits and beaches, possibility of peat formation on the lower parts; 4. the Oer-IJ estuary with channels, sandbanks, clay deposits, back-swamps and lagoons; 5. peat-bog on clay subsoil: eutrophic/mesotrophic peat (part of the habitat 'marsh' of SOVON, 1987); 6. peat-bog on peaty subsoil: eutrophic/mesotrophic peat (part of the habitat 'marsh' of SOVON, 1987); 7. wet moorland: oligotrophic peat; 8. peat (on map a); 9. inlet of the Oer-IJ estuary; 10. still functioning tidal channels of the Dunkirk I system (the Oer-IJ estuary); 11. Frisian sites dated between c. 200 BC and c. 200 AD; 12. Velsen 1; 13. Velsen 2. On map a: A. Velsen; B. Amsterdam (no Roman occupation); C. Valkenburg Z.-H.; D. Meinerswijk; E. Nijmegen; F. Vechten; B and F not used in the text. Drawing J. Morel, IPP.

3. METHODS

The bird remains were identified with the reference collection of the archaeozoology department of the B.A.I. The collection amounted to c. 190 bird species (Clason et al., 1983; Scott Wood & Schnell, 1986) (Lauwerier, 1988, for the need to give this number).

J. Lepiksaar (Göteborg) checked some identifications. The author checked a few identifications with the reference collection of the Archäozoologische Arbeitsgruppe Schleswig-Kiel consisting of skeletons of 304 bird species (Scott Wood & Schnell, 1986). A total number of 3399 bird bones of Velsen 1 were studied, of which 3191 (94%) could be identified (table 1). Figures 4 and 7-10 were processed with Systat. Details on the measurements are available from the author on request (address: Poststraat 6, 9712 ER Groningen, the Netherlands).

Most bird bones could be identified to species. A few identifications are uncertain at the species level.

This has been indicated with 'cf.', if identification is almost certain, with '/' if the choice is between two species (those before and after the '/'), with 'sp.' if the genus is certain, but the species unknown, and with the name of the family (e.g. Fringillidae) if the genus is unknown.

4. POULTRY

At least 81% of the bird bones of Velsen 1 were from domestic birds. Bones of domestic fowl, *Gallus gallus f. domesticus*, were the most common bird bones in Velsen 1. The peacock, *Pavo cristatus*, was represented by one bone, a notarium (the fused 2-5 thoracic vertebrae) (table 1).

4.1. Domestic fowl, *Gallus gallus domesticus*

What is the origin of the many bones of poultry birds in Velsen 1? Before we can answer that

Table 1. Bird remains of Velsen 1, AWN excavations 1973-1980.

Abbr: abbreviations in table 2.

Latin names	English names	Dutch names	Abbr.	N	%
<i>Domestic birds</i>					
Gallus gallus domesticus	Domestic fowl	Huishoen	Gallus	2588	81.1
Pavo cristatus	Peacock	Pauw	Pavo	1	0.0
<i>Wild birds</i>					
Gavia stellata	Red-throated diver	Roodkeelduiker	Gavs	6	0.2
Ardea cinerea	Heron	Blauwe reiger	Arde	1	0.0
Platalea leucorodia	Spoonbill	Lepelaar	Plal	1	0.0
Cygnus olor/cygnus	Mute/whooper swan	Knobbelzwaan/wilde zwaan	cygo	6	0.2
Anser anser	Greylag goose	Grauwe gans	Anser	162	5.1
Anser fabalis	Bean goose	Rietgans	Afab	4	0.1
Anser albifrons	White-fronted goose	Kolgans	Aalb	5	0.2
Anser sp.			Assp	3	0.1
Branta bernicla	Brent goose	Rotgans	Bber	6	0.2
Branta leucopsis	Barnacle goose	Brandgans	Bleu	23	0.7
Tadorna tadorna	Shelduck	Bergeend	Tado	3	0.1
Anas platyrhynchos	Mallard	Wilde eend	Apla	166	5.2
Anas penelope	Wigeon	Smient	Apen	11	0.3
Anas crecca	Teal	Wintertaling	Acre	14	0.4
Anas crecca/querquedula	Teal/garganey	Winter-/zomertaling	crqu	1	0.0
Anas cf. acuta	cf. Pintail	cf. Pijlstaart	Aacu	1	0.0
Anas sp.	Anas species	Anas-soort	Aasp	16	0.5
Aythya fuligula	Tufted duck	Kuifeend	fuli	1	0.0
Aythya marila	Scaup	Toppereend	mari	1	0.0
Bucephala clangula	Goldeneye	Brilduiker	Bcla	2	0.1
Mergus merganser	Goosander	Grote zaagbek	merg	2	0.1
Anatinae	Unknown duck	Onbekende eend	duck	15	0.5
Haliaeetus albicilla	White-tailed eagle	Zeearend	Hali	5	0.2
Lyrurus (Tetrao) tetrix	Black grouse	Korhoen	tetr	9	0.3
Perdix perdix	Partridge	Patrijs	Perd	1	0.0
Grus grus	Crane	Kraanvogel	Grus	101	3.2
Pluvialis apricaria	Golden plover	Goudplevier	Pluv	3	0.1
Philomachus pugnax	Ruff	Kemphaan	Phip	1	0.0
Numenius arquata	Curlew	Wulp	Numa	1	0.0
Scolopax rusticola	Woodcock	Houtsnip	Scol	2	0.1
Gallinago gallinago	Snipe	Watersnip	Galn	2	0.1
Larus argentatus	Herring gull	Zilvermeeuw	Lara	1	0.0
Larus cf. marinus	cf. Great black-back gull	cf. Grote mantelmeeuw	Larm	1	0.0
Columba palumbus	Wood pigeon	Houtduif	Cpal	7	0.2
Turdus pilaris	Fieldfare	Kramsvogel	Tpil	1	0.0
Turdus philomelos	Song thrush	Zanglijster	Tphi	3	0.1
Fringillidae	Finch	Onbekende vink	Frin	1	0.0
Pica pica	Magpie	Ekster	Pica	1	0.0
Corvus corax	Raven	Raaf	Ccox	3	0.1
Corvus cf. frugilegus	cf. Rook	cf. Roek	frug	1	0.0
Corvus corone	Carrion/hooded crow	Zwarte/bonte kraai	coro	6	0.2
Corvus corone/frugilegus	Crow/rook	Kraai/roek	c/fr	2	0.1
Identified wild bird remains				602	
Identified bird remains				3191	
Unidentified bird remains			Indt	208	
Total number of bird remains				3399	
% of identification					94%

question we have to know how the food supply of the soldiers of the Roman army was organized. This food supply had two components: (a) what the soldiers obtained from the army commander, in exchange for a deduction from their pay, (b) what the soldiers supplied themselves, e.g. what they obtained from relatives, bought with their pay from the sutlers and at the canteens that followed the soldiers and were present near each camp, or what they hunted when they were off duty (Davies, 1971: pp. 123-126).

The official supply consisted largely of *frumentum*, wheat. But also bacon, cheese, and probably vegetables and *posca*, sour wine, belonged to the staple diet (Kromayer & Veith, 1928: pp. 331-332, 413; Davies, 1971: p. 125). On feast days this diet was enriched with a wide range of foodstuffs, including meat, against an extra deduction from their pay (Davies, 1971: p. 125). Some army units had their own meadows, *prata*, and game preserve, *vivarium* (Davies, 1971: p. 126; Webster, 1974: p. 255); some of them even had special herdsmen (Webster, 1974: p. 255).

Domestic fowls were probably kept in Roman army camps. They were easy to maintain and provided good food, especially for the ill (Davies, 1971: p. 130). Presumably they were kept by the army unit, but maybe individual soldiers had do-

mestic fowls also, for their meat and eggs.

The sutlers and canteens sold a wide variety of food, including bacon, cheese, meat and drinks. Hunting and fowling will have been another source of meat for the soldiers. They will have gone hunting and fowling as a leisure activity (Barthélemy & Gourevitch, 1975).

Domestic fowls that were kept in the castellum could have had functions other than that of providing eggs, meat, feathers and down, e.g. that of fighting cocks (e.g. Pliny X.24, Paulys, 1913: column 2529) and oracular birds. The oracle through a domestic fowl was often consulted before a battle. The way the animal ate grains was considered as a favourable or inauspicious sign (Paulys, 1913: column 2534). Other functions that domestic fowl had for the Romans were as sacrificial animals and as meals for the deceased (Lauwerier, 1988: p. 143).

The tarsometatarsus of domestic fowl shows secondary sexual dimorphism by the presence or absence of a spur. Three types of tarsometatarsus were found in Velsen I (fig. 2): those without a spur (- in fig. 3), those with a spur (+ in fig. 3) and those with a spur scar (\pm in fig. 3). Those with a spur or spur scar are considered to have been of male domestic fowl. The hen (-) tarsometatarsi are shorter and narrower than those of males (+ and \pm) (fig. 3).² The two sexes are nearly completely separated



Fig. 2. Left tarsometatarsi of domestic fowl, *Gallus gallus domesticus* from Velsen I, ventral aspect; a and b: tarsometatarsi of hens, without spur or spur scar (-); c and d: tarsometatarsi with spur (+), male; e and f: tarsometatarsi with spur scar (\pm), male. N.B. The ligamentous connection surface with the rudimentary metatarsale I (1) should not be mistaken for a spur scar. Scale 1:1.

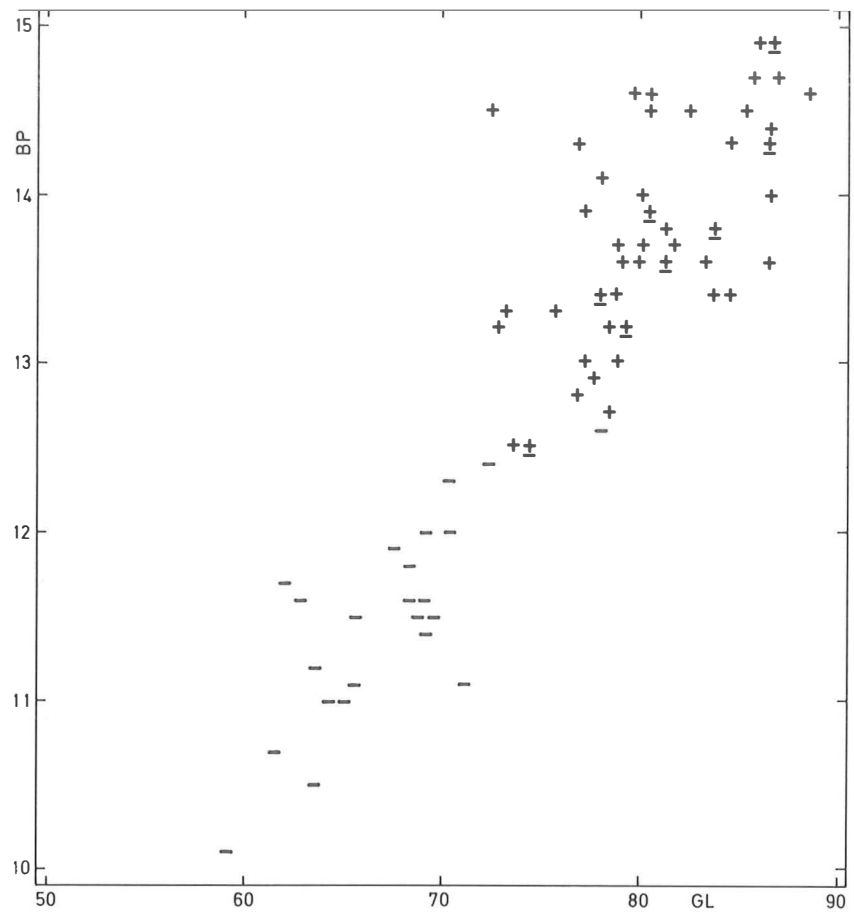


Fig. 3. Plot of proximal width (BP) against maximum length (GL) of *Gallus gallus domesticus* tarsometatarsus of Velsen 1; - without spur or spur scar, + with distinct spur, ± with spur scar (see fig. 2; measurements are in mm).

on this plot. Hens and males were present in Velsen 1 in a proportion of c. 1:2.

Male domestic fowls have more meat than hens. This could explain the preponderance of males. Cock-fighting could be another explanation for the preponderance of males. Male domestic fowls will have been imported especially for their meat or for cock-fighting.

The male tarsometatarsi do not form a homogeneous group, but fall into two categories: a large group of relatively short ones, and a small one of relatively tall ones (fig. 3). This subdivision does not coincide with the difference with respect to spurs (+ or ±). In spite of some recent studies on spur scars (West, 1982; 1985; Bökönyi & Bartosiewicz, 1983; Coy, 1983) their nature is still rather obscure. In another paper I hope to give conclusions on the spur types and the variation in total length of the male tarsometatarsi.

In the neighbourhood of Velsen 1 contemporary Frisian sites (farms) have been found (Vos, 1983; Brandt, 1983; Hallewas, 1987) (fig. 1). No bones of domestic fowl have been demonstrated in these sites (Seeman, 1987; van Wijngaarden-Bakker, 1988).

Archaeological data (van Beek, 1987: p. 288; Morel, 1987: p. 174) indicate that no relations existed between the Roman army personnel of Velsen 1 and the native population in the Frisian sites, or at least that they "have yet to be demonstrated" (Morel, 1987: p. 174). The absence of domestic fowl bones in the native sites and their abundance in the contemporary Velsen 1 support the conclusion of absence of relations. The absence of relations with the Frisian sites excludes the possibility that the army commanders or the cantabrigs bought domestic fowl from the local inhabitants.

The earliest sites in the Netherlands with large numbers of bones of domestic fowl are Roman military sites. These are, apart from the castellum of Velsen 1, the castellum of Valkenburg (Z.H.) (Clason, 1967B: table 24), the castra and canabae legionis of Nijmegen (Lauwerier, 1988: tables 2, 11, 14, 17), and the castellum of Meinerswijk (Lauwerier, 1988: table 27). Outside the Roman military settlements domestic fowl bones were rather scarce in the first few centuries AD (Lauwerier, 1988: table 36; Clason, 1978).



Fig. 4. Three tibiotarsi of *Gallus gallus domesticus*, domestic fowl; a: a healthy left tibiotarsus; b and c: right tibiotarsi with osteopetrosis (I). Scale 1:1.

About 1% of the domestic fowl of Velsen suffered from osteopetrosis, a rare viral disease, that presumably is a form of visceral leucosis (Voeten, 1974: pp. 116-119; Siegel, 1976: p. 366). This non-lethal disease caused a thickening of the middle part (corpus) of the long bones, which will have hindered walking. Egg laying may have been hampered (Voeten, 1974: p. 119). A coracoid, 3 humeri, 3 radii, 2 ulnae, 2 femora, 13 tibiotarsi and 2 tarso-metatarsi showed this type of swelling of the corpus (fig. 4).

4.2. Peacock, *Pavo cristatus*

A notarium of a peacock has been found (fig. 5). The notarium of galliforms is the fused series of the 16th cervical and 1st-3rd thoracic vertebrae (King & McLelland, 1984: pp. 53-54). The identification of this notarium as peacock has been established on the basis of the development and shape of the *crista ventralis* of the individual vertebrae.

The *crista* of the 2nd and 3rd thoracic vertebrae of the peacock proves to be absent, whereas in domestic fowl the *cristae* of these vertebrae are

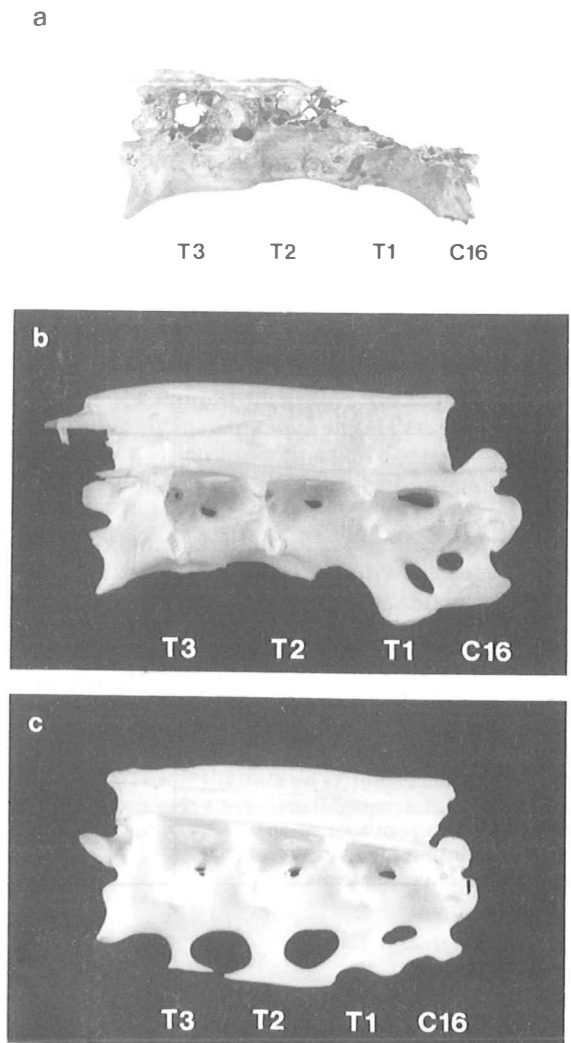


Fig. 5. Notarium (fused 16th cervical and 1st-3rd thoracic vertebrae) of peacock, *Pavo cristatus* (a) of Velsen 1, right side view. For comparison the notaria of recent peacock (b) and domestic fowl (c) have been depicted. The identification as peacock has been established on the basis of the absence of a *crista ventralis* of the 2nd and 3rd thoracic vertebrae and the weak development of the *crista* of the 1st thoracic vertebra. Scale 1:1; C16, T1-3. number of cervical (C) or thoracic (T) vertebra.

distinctly present. The *crista* of the 1st thoracic vertebra of the peacock notarium is weakly developed, that of domestic fowl distinctly (fig. 5). The feature was demonstrated on the basis of the reference material of the B.A.I. and that of the Institut für Haustierkunde der Universität Kiel (B.R.D.). The large size of the notarium of Velsen 1 was another argument for identification as peacock.

The peacock find of Velsen 1 is the earliest find of peacock in the Netherlands. Lauwerier (1988) did not find this species in Nijmegen. The peacock, that is native to India and Ceylon, will have been

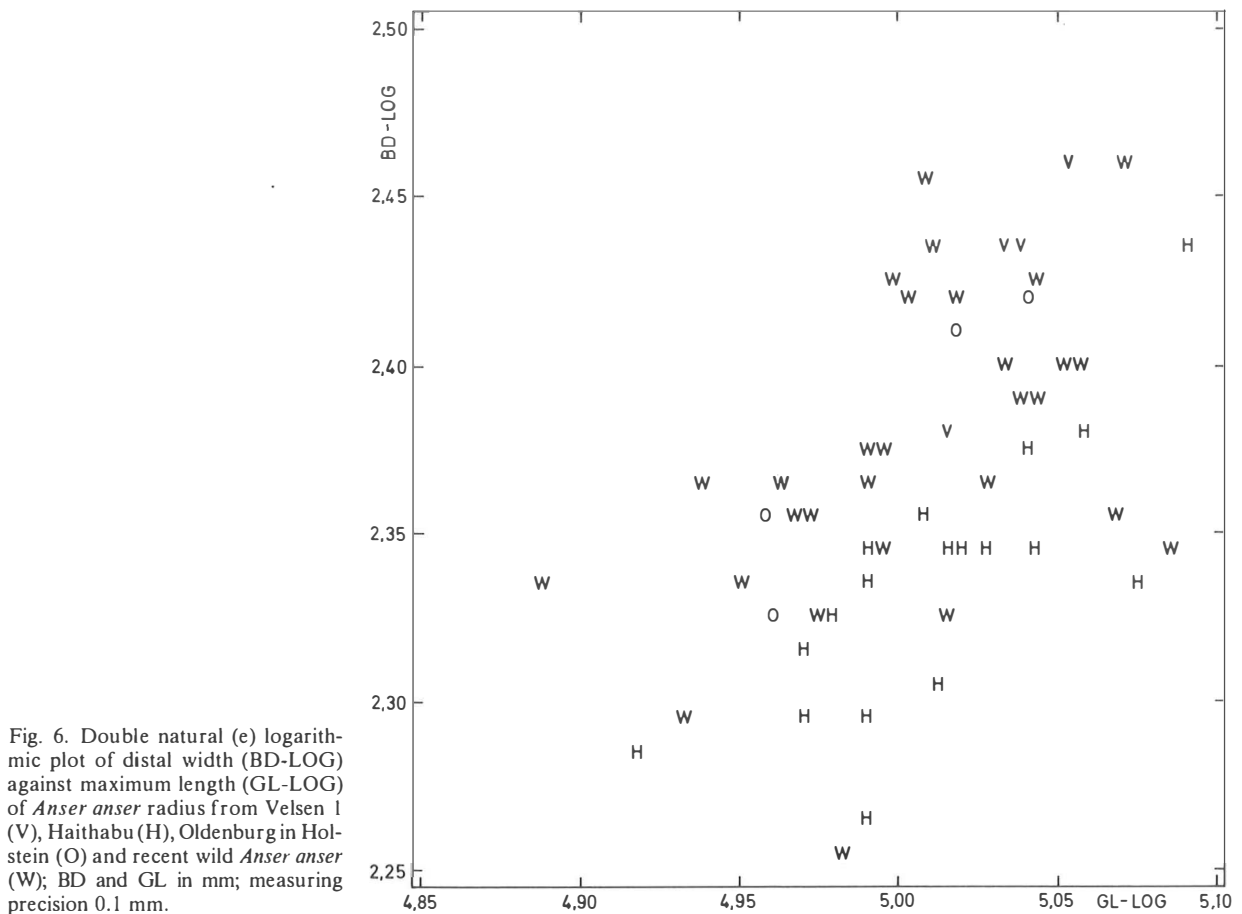


Fig. 6. Double natural (e) logarithmic plot of distal width (BD-LOG) against maximum length (GL-LOG) of *Anser anser* radius from Velsen I (V), Haithabu (H), Oldenburg in Holstein (O) and recent wild *Anser anser* (W); BD and GL in mm; measuring precision 0.1 mm.

brought to Velsen I by the Roman army. Peacocks will have been very scarce in the Netherlands in the Roman period. The peacock was highly esteemed by the Romans. Columella (VIII.11) gives a practical guideline how to rear peacocks. Apicius (1st century AD, revised 4th century) gives a recipe for peacock meat (II.2.6).

5. WILD BIRDS

At least 36 wild bird species have been demonstrated among the bones of Velsen I (table 1). The most important wild birds are mallard, *Anas platyrhynchos*, (n=166) and crane, *Grus grus*, (n=101). The bones of these species represent respectively 5 and 3% of the identified bird bones of Velsen I (table 1).

Anser anser, the greylag goose, was represented by 162 bones, i.e. 5% of the identified bones. Two varieties are known of this species, the wild and the domestic one. The identification of the two varieties in their skeletal elements is difficult. Reichstein & Pieper (1986: pp. 93-99) gave a possible solution in

their discussion on the greylag goose bones from early medieval Haithabu. They (1986: Abb. 17-18) compared on log-log plots the length and width measurements of the Haithabu greylag goose bones with those of recent wild greylag geese from Central Europe. They found range and mean of the length measurements of the goose bones from Haithabu to be largely identical with those of the wild greylag goose.

The width measurements differed from each other: the wing bones (humerus, radius, ulna, carpometacarpus) of the Haithabu geese were narrow in comparison with those of the recent wild greylag geese of equal length. In contrast, the leg bones (femur, tibiotarsus, tarsometatarsus) of the Haithabu geese were wide in comparison with those of the wild greylag geese of identical length. Reichstein & Pieper (1986: p. 99) proposed for this difference in proportion the hypothesis that the Haithabu geese were less used to flying than the wild geese and were therefore presumably domestic geese. The greylag goose bones of the early medieval site of Oldenburg in Holstein show about the same length – width proportions as those of Haithabu,

and are therefore presumably from domestic geese.

The few length measurements of Velsen I greylag goose that could be taken from complete bones (table 3), fell in the upper half of the range of length measurements of the geese of Oldenburg and Haithabu and of the recent wild greylag geese (Reichstein & Pieper, 1986: Tab. 127 and 128) (figs 6-9).

The greylag goose radius and ulna of Velsen I (V) were wide in comparison with those of Haithabu (H) and Oldenburg (O). The width-length proportions of the Velsen I geese approximate more closely to those of the wild greylag goose (W) (figs 6 and 7). The Velsen I femur resembles that of the wild goose, which is narrow in comparison with the femur of Haithabu and Oldenburg (fig. 8). The association of the Velsen I goose tarsometatarsus with the wild goose is weaker (fig. 9). The largest Velsen I tarsometarsi could fall in the overlap between the tarsometatarsi of wild and domestic geese. Humerus, carpometacarpus and tibiotarsus bones were too few in Velsen I to permit any conclusions on the possible wild or domestic state of the geese they came from.

In conclusion, the greylag geese of Velsen I had

the relatively wide wing bones of the recent wild goose and its relatively narrow leg bones (figs 6-9). This may be taken as an indication that the greylag geese of Velsen I were wild. Because the greylag goose bones from Velsen I were rather long, we have to conclude that the soldiers caught large wild greylag geese. These large geese may have been males.

At present the greylag goose is a rather common wild goose species in the Netherlands. Its present abundance fluctuates between 4000 and 13,000 specimens (SOVON, 1987: pp. 98-99). The species is present during the whole year. In the 1st century AD the species definitely will have bred in the vicinity of Velsen I.

It should be mentioned that the number of greylag goose bones of Velsen I that could be measured, was not very large (table 1). To some extent confusion may have occurred with the bones of *Anser fabalis*, bean goose. In winter this species is present in the Netherlands in even larger numbers than the greylag goose (SOVON, 1987: pp. 92-93). The dimensions of the skeletal elements of the two species largely overlap (Bacher, 1967). Morphologi-

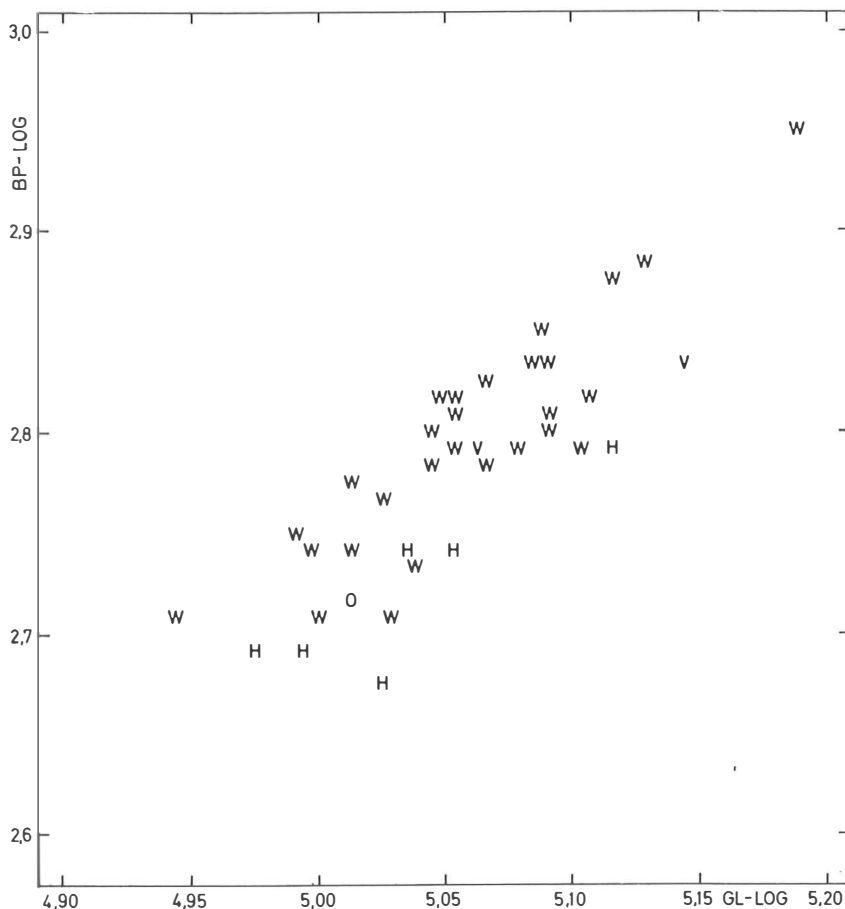


Fig. 7. Double natural (e) logarithmic plot of proximal width (BP-LOG) against maximum length (GL-LOG) of *Anser anser* ulna from Velsen I (V), Haithabu (H), Oldenburg in Holstein (O) and recent wild *Anser anser* (W); BD and GL in mm; measuring precision 0.1 mm.

cal features permit identification.

The other c. 32 wild bird species are represented by small numbers of remains (less than 1% of the number of identified bird bones (table 1)).

6. ROMAN FOWLING METHODS

No Roman handbook on fowling has been preserved (Lindner, 1973: pp. 16-17). This means that hardly any details are known about the fowling methods for particular groups of birds. From the classical writers it is known that the fowling equipment was extensive. Nets, bird-lime, snares, traps, bird-whistles, frightening birds and decoy-birds were used in fowling in classical times (Daremberg & Saglio, 1913-1918: p. 694; Lindner, 1973; Barthélemy & Gourevitch, 1975: p. 369).

The last authors mention the use of birds of prey as decoy-birds, such as eagle, vulture, harrier and raven. The quarry, attacking the bird of prey or raven to drive away it, is caught with a net or snare. For pigeons and thrushes the *harundo*, the compound lime-twigg, was used (see 7.6).

In the 1st century AD fowling will have been a form of sport, thus a leisure activity (Lindner, 1973; Barthélemy & Gourevitch, 1975). But the supply of meat (or feathers, see 8.1) will always have been an important impetus for fowling.

In chapter 7 and 8 I will discuss the wild birds of table 1 in groups that may have been connected with different types of fowling practised by the Romans. Size, habits, presumed value of the meat and possible functions were the criteria for the grouping. The groups of birds are discussed in the order of their frequencies, and thus in the probable order of importance. The bird species that presumably died a natural death are discussed in chapter 9.

7. GAME BIRDS

7.1. Duck fowling

Nine species of wild ducks are represented by bones: mallard, teal, wigeon, shelduck, goldeneye, goosander, pintail, tufted duck and scaup (table 1). I assume that the unidentified duck bones are from

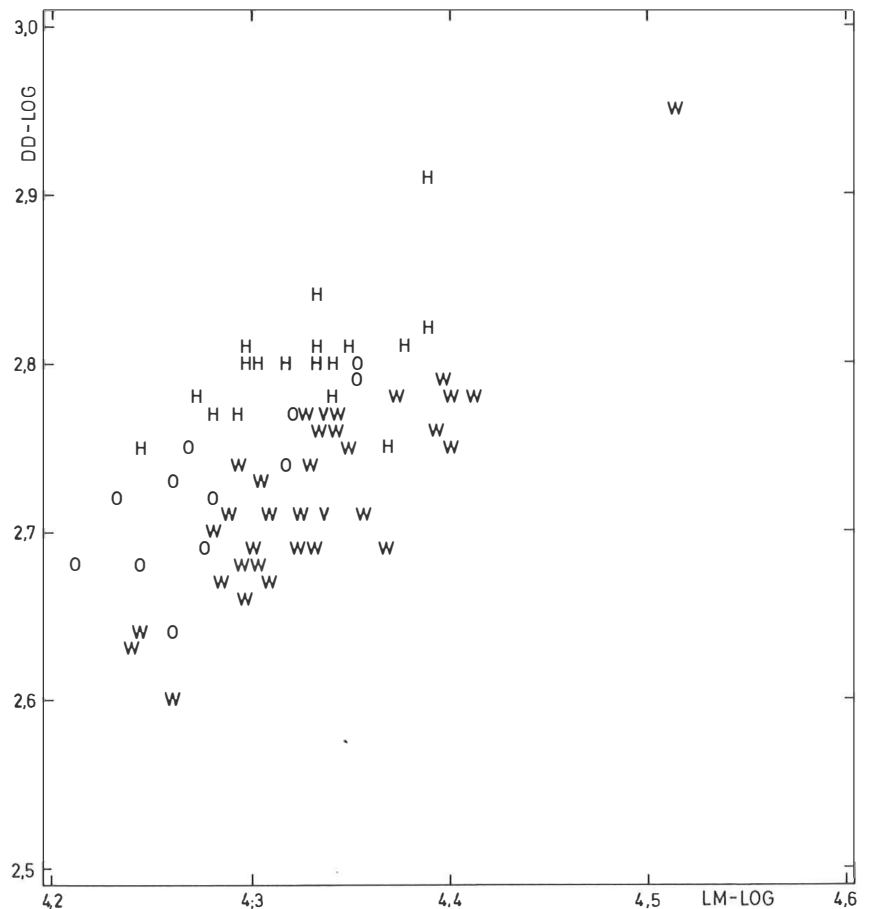


Fig. 8. Double natural (e) logarithmic plot of distal depth (DD-LOG) against medial length (LM-LOG) of *Anser anser* femur from Velsen 1 (V), Haithabu (H), Oldenburg in Holstein (O) and recent wild *Anser anser* (W); BD and GL in mm; measuring precision 0.1 mm.

these species also. With a total of 233 bones the ducks are the best represented group of wild birds.

The length and width measurements of the mallard bones fit perfectly within the ranges of recent wild mallard, *Anas platyrhynchos*, studied by Reichstein & Pieper (1986: Tab. 125). Their means are nearly identical with the means of the recent wild mallard measurements. For this reason I consider the mallard bones of Velsen I to be of wild mallard. Columella (VIII.15) gives instructions for the keeping of ducks (mallard, teal and garganey) and other waterfowl, which was much more difficult than that of domestic fowl (VIII.2-7). This supports my opinion that the mallard bones in Velsen I were of wild animals.

Shelduck, mallard, wigeon, teal, pintail and tufted duck are present in the Netherlands during the whole year, as breeding birds, migrants and winter visitors. Apart from the mallard, whose densities are rather constant, these species are present nowadays in the winter half of the year (October-March) in larger densities than in summer (SOVON, 1987). Scaup, goldeneye and goosander are migrants and winter visitors in the Netherlands with a few not-

breeding individuals being present in summer (SOVON, 1987: Appendix 5).

The data on the presence of the nine species of ducks during the year indicate that duck fowling was possible the whole year round. In the winter half of the year it would have been even more profitable than in summer.

Ducks will have been caught for their meat. Whether the Roman soldiers did the fowling themselves or bought them from the native population cannot be deduced from the bones themselves. An argument against the latter possibility is that bones of wild birds were scarce in the Frisian farms in the neighbourhood of Velsen I (Seeman, 1987; van Wijngaarden-Bakker, 1988). As said before (chapter 4.1), presumably no relations existed with the local population. Presumably fowling was a leisure activity for the soldiers.

Three habitat types are visited in the summer and the winter half of the year by the nine duck species found in Velsen I. These are (1) coastal dunes and beach, (2) marshland and water and (3) wet moorland (SOVON, 1987: Appendix 5). These three habitat types were present in the vicinity of Velsen I

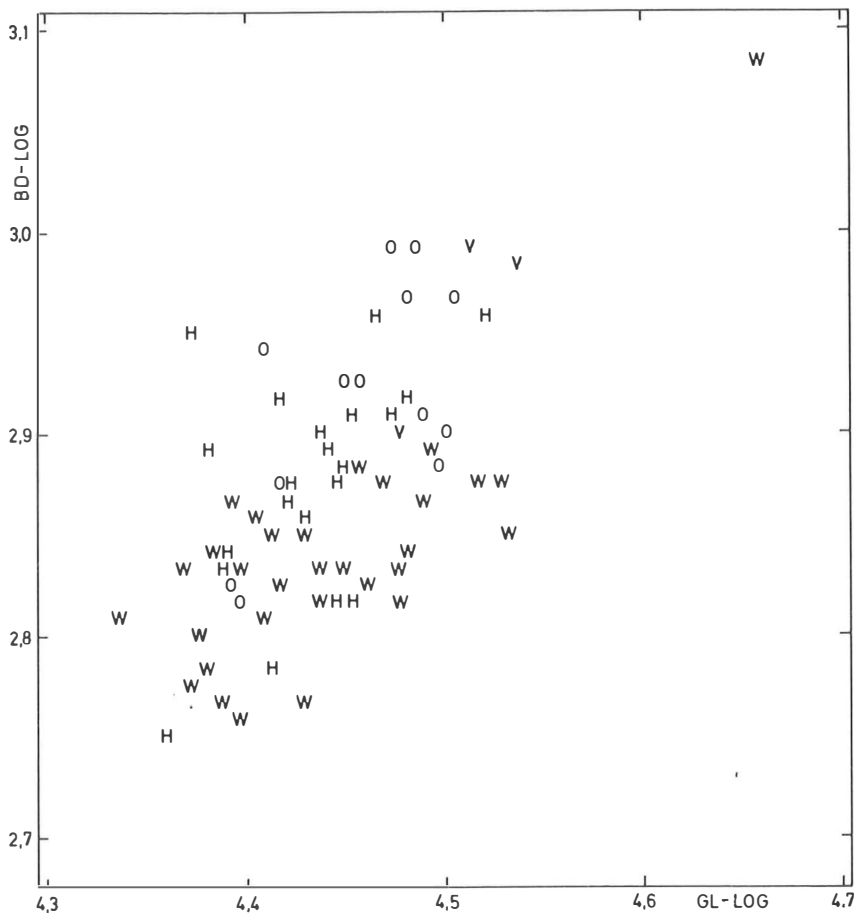


Fig. 9. Double natural(e) logarithmic plot of distal width (BD-LOG) against maximum length (GL-LOG) of *Anser anser* tarsometatarsus from Velsen I (V), Haithabu (H), Oldenburg in Holstein (O) and recent wild *Anser anser* (W); BD and GL in mm; measuring precision 0.1 mm.

(Groenman-van Waateringe & Troostheide, 1987; de Jong, 1987; Pals, 1987) (fig. 1). The Oer-IJ estuary itself will have been an important habitat for ducks. On the maps of the SOVON report (1987: pp. 110-149) it can be seen that the nine duck species still occur in the area of Velsen, although the peat-bog and the wet moorland have been replaced by meadows, arable fields, canals and lakes.

7.2. Goose and swan fowling

Five species of wild geese were hunted by the soldiers of Velsen 1: greylag goose (see chapter 5 for a discussion on the wild state of this species in Velsen 1), barnacle goose, brent goose, white-fronted goose and bean goose. Together with the unidentified *Anser* bones, a total of 203 goose bones have been demonstrated in Velsen 1.

The greylag goose is present in the Netherlands during the whole year. In the 1st century AD the species may have been a breeding species in the Netherlands. The breeding habitat, marshland, was abundant in the area of Velsen 1 (fig. 1). In winter the number of greylag geese is greatly increased by the arrival of migrants and winter visitors (SOVON, 1987: pp. 98-99, Appendix 5).

Barnacle goose, brent goose, white-fronted goose and bean goose are migrants and winter visitors in the Netherlands (SOVON, 1987). Barnacle and brent goose are present in high numbers from September until June, white-fronted and bean goose from December until April. In the other months these species are present in the Netherlands in very low numbers (SOVON, 1987: pp. 92-107).

Fowling for geese other than the greylag goose must have been practised in the winter half of the year. Greylag goose hunting could have been practised during the whole year.

The brent geese that migrate and winter in the Netherlands are restricted to coastal dunes and beaches (SOVON, 1987: pp. 106-107). The other goose species represented by bones in Velsen 1 occupy marsh and water habitats (SOVON, 1987). The goose species found in Velsen 1 still visit the area of the site. The soldiers could have caught geese on the coast, on the Oer-IJ estuary or in the peat-bog at short distances from the castellum (fig. 1).

The swan bones are of whooper swan or of mute swan. At present feral mute swan live in the low lying areas of the Netherlands in large numbers during the whole year. Whether the mute swan bred in the Netherlands in the 1st century AD is uncertain. The earliest records of breeding mute swan are from the 1930s (Teixeira, 1979: pp. 50-51). In any case the mute swan will have been a migrant and winter visitor. The whooper swan is migrant and winter visitor from November until April, as it probably was also in the 1st century. Presumably swan fowling was done in the winter half of the year.

7.3. Crane fowling

Crane bones (fig. 10) were abundant among the wild bird bones in Velsen 1 (table 1). A total of 101 crane bones has been found on 602 bones of wild birds, which is 17%. At present the crane is a spring (March-April) and autumn (October-November, sometimes December) migrant in the Netherlands. On the spring migration most cranes are seen over the eastern half of the Netherlands, on the autumn migration they follow a wider track over the Netherlands, that also includes the Oer-IJ area. In the other months than those of the spring and autumn migration, cranes are seldom seen. Nowadays in the Netherlands most cranes are observed only on the wing (SOVON, 1987: pp. 202-203).

The author of the 'Jacht-Bedryff' of 1636, presumably Cornelis Jacobsz. van Heenvliet, the forester of Holland and West-Friesland, remarks that formerly the crane did breed in the moorlands of Holland. He saw the growth of human population on the moorlands as the cause of the loss of the crane as a breeding species (Swaen, 1948: pp. 67, 74).

In the 1st century AD the habitat for breeding cranes in the area described by the 'Jacht-Bedryff' definitely was intact. Presumably cranes bred on the wet moorlands that were a short distance away from Velsen 1 (the nearest at c. 4 km) (fig. 1) (Vos, 1983: fig. 6; Morel, 1986: fig. 1). The breeding cranes will have left the Netherlands in autumn, together with the migrants.

The breeding cranes could have been hunted in summer, while in autumn or spring migrating cranes that came to rest in the peat-bog or on the wet moorland will have been available to fowlers. Migrating cranes that passed over Velsen 1 without coming down to rest will not have been hunted, because they fly too high.

The Romans highly esteemed the crane as a bird for the table. Apicius gives five recipes for preparing crane (book VI). Some of the recipes of Apicius may date from the 4th century AD, however. Varro (III.2.14) mentions the keeping of cranes on an Italian villa.

7.4. Fowling for black grouse and partridge

These species are represented by small numbers of remains (table 1). They will have been caught occasionally. Both species are residents in the Netherlands. The individual birds hardly move from their breeding ground. At present the existence of the black grouse in the Netherlands is endangered. The only breeding grounds are wet moorlands and heathland in the eastern half of the Netherlands, and along the border with Belgium (SOVON, 1987: pp. 184-185).

The wet moorland environment in the surroundings of Velsen 1, east of the Frisian sites, may have

been a good habitat and breeding ground for the black grouse in the 1st century AD. By the beginning of the 17th century hardly any black grouse had survived in the moors of Holland ('Jacht-Bedryff', Swaen, 1948: p. 39). The medieval reclamations will have destroyed their habitat.

At present the partridge occupies nearly the whole of the Netherlands, although their numbers are declining (SOVON, 1987: pp. 186-187). Their present habitat consists of well-drained pastures and arable fields, with some shelter in the form of hedges, small woods etc. During the 1st century this habitat in the surroundings of Velsen probably was scarce. The partridge will have been present, but probably in low densities.

Partridge bones are scarce in archaeozoological material. Apart from in Velsen I, partridge has only been found in the 11th-12th century castle of Valkenburg in Limburg (Clason & Prummel, 1979). Probably partridge was scarce in the Netherlands until the late Middle Ages or even later. The partridge may have benefited from the reclamation of woods and wetlands.

These gallinaceous game species will definitely have been caught for their meat.

7.5. Fowling for golden plover, ruff, curlew, woodcock and snipe

In medieval times these birds of the families Charadriidae and Scolopacidae were well-known for their good flavour (e.g. Taillevent; le Ménagier de Paris; Sass, 1975: *Forme de Cury*). Probably the Roman soldiers esteemed the meat of these species. They may have been caught as additional quarry of duck or geese fowling with nets.

The golden plover breeds on wet moorland or wet heather. The species may have bred in the vicinity of Velsen I, because these habitats existed there in the 1st century AD (fig. 1). During the autumn and spring migration periods the golden plover will have been present in even larger numbers, as the species migrates in large groups over the coastal area (SOVON, 1987: pp. 218-219), and may then be caught rather easily (Eenshuistra, 1973).

In the Netherlands the ruff is a breeding species of wet marshland. The conditions for breeding will certainly have been fulfilled in the area of Velsen. After breeding the ruffs depart. From November until March rather few ruffs, migrants and winter visitors from northern Europe, are present in the Netherlands (SOVON, 1987: pp. 238-239). The ruff will have been most easily caught in the summer half of the year.

Nowadays curlews are present in the Netherlands during the whole year. In the coastal area they are more numerous than far inland. Some of the breeding birds migrate in a southerly direction

after breeding. From North and northeastern Europe curlews migrate in winter over the Netherlands or arrive there as visitors (SOVON, 1987: pp. 252-253). The curlew could have been caught throughout the whole year.

In the Netherlands the woodcock is a breeding bird, a migrant in spring and autumn and a winter visitor. Its habitat is deciduous forest. The woodcock is most frequently observed during the spring and autumn migrations. At present the woodcock occurs in the dunes close to Velsen (SOVON, 1987: pp. 244-245). The woodcock will have bred in the dunes close to Velsen I (Morel, 1986: fig. 1). Presumably the woodcocks migrating in spring or autumn were the easiest to catch.



Fig. 10. Bones of crane, *Grus grus*, from Velsen I; a: scapula R; b: coracoid L; c: humerus R; d: radius R; e: ulna R; f: carpometacarpus R; g: tibiotarsus L; h: tarsometatarsus L (L = left, R = right). Scale 1:2.

The breeding habitat for the snipe will have been optimally present in the surroundings of Velsen 1: coastal dunes, peat-bog and wet moorland were close by. During the spring and autumn migration periods snipe are present in greatest abundance (SOVON, 1987: pp. 242-243). These times of the year will have provided the best opportunities for catching snipe.

7.6. Fowling for wood pigeon, fieldfare and song thrush

Seven bones of wood pigeon have been found. Fieldfare and song thrush were represented by one and three bones respectively (tables 1 and 2). At present the wood pigeon is a very common species in the Netherlands throughout the whole year. It may have been hunted during the whole year.

The fieldfare is present in high numbers in the winter half of the year (October-April), as a passage migrant and a winter visitor. In summer their numbers are fewer. Since the 1970s the fieldfare is a breeding species in the Netherlands (SOVON, 1987: pp. 404-405). Whether that was the case in the 1st century AD is uncertain. The best season for fowling for fieldfares will have been winter.

The song thrush is present in the Netherlands during the whole year. From March until November their numbers are greatest (SOVON, 1987: pp. 406-407). In that period of the year fowling may have been most profitable.

At villae in the Mediterranean part of the Roman Empire wood pigeons (Columella VIII.8), and fieldfares and thrushes (Varro III.5, Columella VIII.10) were reared in large well-shut cages. Such cages will not have been present at castella.

The Roman élite practised a particular method of fowling for wood pigeons, thrushes and smaller birds as a form of sport. This was fowling with the compound lime-twig, *harundo*, *kalamus* or *calamus*, that has been recorded in pictures and literary sources (Lindner, 1973; in less detail: Barthélemy & Gourevitch, 1975).

The compound lime-twig consisted of a set of bamboo twigs, that could be connected to make a very long twig, in the same way as a telescopic fishing-rod. At the top of the upper section of the twig a little stick was connected that was dipped in a container with bird-lime. The fowler approached a tree or bush in which birds that he wanted to catch were sitting. He extended the top section of his compound lime-twig with the lime-stick on top of it. Very quietly he connected a second bamboo section under the section, and extended the lime-stick closer to the quarry. He continued connecting bamboo sections till he could attain the quarry. Silence and dexterity were essential for this method of fowling (Lindner, 1973).

The quarry was caught at his wings or body. For each bird a new stick with lime was used. A bird of prey sitting on the shoulder of the fowler could be used to frighten the quarry. The fowler picked from the tree the terror-stricken bird that hid itself in the foliage. Lindner (1973: p. 96) supposes that the birds of prey used for this purpose were hobby, *Falco subbuteo*, kestrel, *Falco tinnunculus* and sparrow-hawk, *Accipiter nisus*.

Maybe the commanders of the castellum fowled in this way for sport. Parker (1988: pp. 204-205) proposed the same for Roman Britain. Other methods would have been the use of nets or snares with or without bird-lime.

8. BIRDS NOT HUNTED FOR THEIR MEAT

8.1. The white-tailed eagle

Five bones of this species have been found: 2 radii and 3 toe phalanges 3 (tables 1 and 2). At present the white-tailed eagle is a rare passage migrant and winter visitor in the Netherlands. The vicinity of Velsen is one of the places where the white-tailed eagle has been seen between 1979 and 1983 (SOVON, 1987: p. 156).

Archaeozoological finds indicate that the white-tailed eagle was more abundant in the Netherlands in the past (e.g. Clason, 1967; Prummel, 1987). Whether the species bred in the Netherlands in prehistoric times is uncertain, but possible. The western and northern low-lying half of the Netherlands may have been its breeding territory in the Netherlands, as the white-tailed eagle needs fresh water in the area of his breeding ground (Looft & Busche, 1981: pp. 53-64).

White-tailed eagle will have been sought after because of their wing and tail feathers, that were used for the fletching of arrows (Clark, 1948). Reichstein & Pieper (1986: pp. 60-61) found that in the Haithabu bones of the white-tailed eagle the number of wing bones outnumbers that of the leg bones by far. The same phenomenon is evident at the Dutch Neolithic (e.g. Vlaardingen and Zandwerven: Clason, 1967; Hekelingen: Prummel, 1987) and Roman (Valkenburg: Clason, 1967) sites. The wings (and the tail feathers) will have been cut from the hunted eagles, and have been brought into the site.

8.2. Magpie, raven, rook(?) and crow: fowler's help?

These species presumably have not been eaten. Apicius (VI) does not give any recipes for the preparation of their meat, and in later cookery books these species are not mentioned either. Their

possible function for the soldiers is discussed at the end of this chapter.

Magpie, raven and crow are residents in the Netherlands (SOVON, 1987: Appendix 5). Magpie and crow inhabit the whole of the Netherlands in large numbers. The magpie has largely benefited from the dense human occupation in the Netherlands. In the 1st century AD it may have been less abundant than nowadays.

In the first half of the 20th century the raven was extinct in the Netherlands. After the release of 159 ravens between 1969 and 1986, the species nowadays inhabits the Veluwe and the dunes of North and South Holland in low densities (SOVON, 1987: p. 483). Presumably the raven bred in the forest on the dunes near Velsen 1.

The rook is a colony breeder in deciduous forest, especially in the eastern half of the Netherlands. In the winter half of the year large numbers of rooks from eastern Europe visit or migrate over the Netherlands. The number of rooks observed at present in the neighbourhood of Velsen is rather low (SOVON, 1987: pp. 486-487). This suggests that the definite presence of this species at Velsen is indeed questionable.

Pliny (X.15) mentions, as an anecdote, the oracular function of the raven. It was taken as a bad omen

when the raven did not make its typical hoarse croak, but made a noise as if it was choking. In X.60, Pliny mentions ravens that, sitting on the helmet or shoulder of a fowler, help him with fowling (see Barthélemy & Gourevitch, 1975: p. 369). Pliny also mentions talking magpies, ravens and crows (X.59-60).

Concerning the function of these species in Velsen 1 nothing can be said with certainty. Tamed ravens, maybe crows also, could have been used in fowling, to attract the quarry. Maybe they were pets for the soldiers. The birds could just have died a natural death.

9. BIRDS PRESUMABLY NOT FOWLED OR CONSUMED

9.1. Fish-eating birds; red-throated diver, heron and spoonbill

The red-throated diver (tables 1 and 2) will have been present as a migrant and winter visitor along the coast and on the Oer-IJ between October and May. In summer few individuals are present (SOVON, 1987: pp. 44-45). The heron is present in the wet, marshy areas of the Netherlands the whole year

Table 2. Number of skeletal elements per bird species. For abbreviations see table 1.

	Gallus	Pavo	Gavs	Arde	Plal	cygo	Anser	Afab	Aalb	Assp	Bber	Bleu	Tado	Apla	Apen	Acre	crqu	Aacu	Aasp	fuli	mari
Cranium	15	-	-	-	-	-	1	-	1	-	-	1	-	4	1	-	-	-	-	-	-
Mandibula	5	-	-	-	-	-	2	-	-	-	-	-	-	4	-	-	-	-	-	-	-
Vertebrae	6	1	-	-	-	-	9	-	-	-	-	-	-	6	-	-	-	-	-	-	-
Notarium	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sacrum	36	-	-	-	-	-	3	-	-	-	-	-	-	5	-	-	-	-	-	-	-
Costae	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Sternum	64	-	-	-	-	-	8	1	-	-	-	2	-	7	-	1	-	-	1	-	-
Clavicula	50	-	-	-	-	-	4	-	-	-	-	1	-	4	-	-	-	-	-	-	-
Coracoid	242	-	-	-	-	-	13	1	-	-	-	1	-	29	1	2	-	-	1	1	-
Scapula	131	-	-	-	-	1	6	-	-	-	-	1	-	10	-	1	-	-	-	-	-
Humerus	293	-	1	-	-	-	27	-	1	-	1	3	2	18	4	4	-	-	1	-	-
Radius	300	-	2	-	-	2	29	-	1	-	1	5	-	27	1	2	-	-	3	-	-
Ulna	237	-	-	-	-	1	18	1	1	2	1	3	1	15	-	2	-	-	5	-	-
Carpometacarpus	95	-	2	-	-	2	6	1	1	1	1	3	-	16	1	1	-	-	1	-	1
Phalanges, wing	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pelvis	73	-	-	-	-	-	7	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Femur	215	-	-	-	-	-	6	-	-	-	-	-	-	2	-	-	-	-	1	-	-
Tibiotarsus	543	-	-	-	1	-	15	-	-	-	-	2	-	15	3	1	1	1	1	-	-
Fibula	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tarsometatarsus	270	-	1	1	-	-	5	-	-	-	2	1	-	2	-	-	-	-	1	-	-
Phalanges, foot	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Unknown element	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	2588	1	6	1	1	6	162	4	5	3	6	23	3	166	11	14	1	1	16	1	1

round. The spoonbill is only a summer visitor (SOVON, 1987: pp. 76-77). It breeds in colonies on marsh (SOVON, 1987: pp. 84-85; Teixeira, 1979: pp. 48-49).

It is unlikely that these species were eaten in Velsen 1. Because of their diet, that largely consists of fish and shellfish (Cramp & Simmons, 1977: pp. 46, 306, 355), their meat may have been less esteemed. Apicius did not mention any of them in his recipes for birds (Apicius VI). Pliny (X.79) does comment on the mating of heron, but not on their flavour. Presumably specimens of red-throated diver, heron and spoonbill died a natural death in the Oer-IJ, or they were unintentionally caught in fishing gear.

9.2. Gulls

The herring gull and the great black-backed gull (tables 1 and 2) presumably had no function for the castellum. Their scavenging habits (Cramp & Simmons, 1983: pp. 821, 853) possibly spoilt the flavour of their meat, but nothing is known about attitudes of the Romans towards gull meat. Apicius gave no recipes for gull meat. Pliny (X.48) does not mention that they were consumed.

10. SUMMARY

Among the birds consumed by the soldiers of the Roman castellum Velsen 1 (c. 15-30 AD), domestic fowl was by far the most numerous. Male domestic fowls outnumbered hens about twice, possibly because of a function of the former as fighting cocks. Presumably domestic fowls were reared at the castellum itself. Peacock was kept in Velsen 1, but in small numbers.

At least 36 wild bird species have been demonstrated, of which mallard, greylag goose and crane were the most numerous by far. These species are considered to represent three main types of fowling by the soldiers on the habitats in the surroundings of the site: (1) duck fowling on the Oer-IJ, the peat-bog, the wet moorland or the coast, (2) goose and swan fowling on the Oer-IJ, the peat-bog or the coast, (3) crane fowling on the wet moorland. Duck, goose and swan fowling were possible during the whole year, but more profitable in winter because of the larger densities of birds. Most of these species are present in winter only. Crane fowling was possible in spring, summer and autumn.

Three minor types of fowling have been distinguished: (4) fowling for black grouse and par-

	Bcla	merg	duck	Hali	tetr	Perd	Grus	Pluv	Phip	Numa	Scol	Galn	Lara	Larm	Cpal	Tpil	Tphi	Frin	Pica	Ccox	frug	coro	c/fr	indt
Cranium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Mandibula	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vertebrae	-	-	3	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Notarium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sacrum	-	-	-	-	1	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Costae	-	-	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sternum	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Clavicula	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coracoid	-	1	-	-	2	-	4	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-
Scapula	-	-	-	-	-	-	6	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Humerus	-	-	4	-	-	1	7	1	-	-	-	-	1	-	1	1	-	-	-	-	-	1	-	-
Radius	1	-	2	2	-	-	11	-	-	1	-	-	-	-	1	-	-	-	-	-	-	1	-	-
Ulna	-	1	2	-	-	-	9	-	-	-	-	-	-	-	1	-	1	1	-	1	-	2	1	-
Carpometacarpus	1	-	-	-	-	-	8	-	-	-	-	2	-	-	2	-	-	-	-	-	1	-	-	-
Phalanges, wing	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Pelvis	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Femur	-	-	-	-	2	-	-	-	-	-	-	-	-	-	2	-	-	-	-	1	-	-	-	-
Tibiotarsus	-	-	1	-	-	-	10	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Fibula	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tarsometatarsus	-	-	-	-	4	-	28	2	-	-	-	-	1	-	-	-	1	-	1	-	-	1	1	-
Phalanges, foot	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19
Unknown element	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	186
Total	2	2	15	5	9	1	101	3	1	1	2	2	1	1	7	1	3	1	1	3	1	6	2	208

tridge on the wet moorland or the coastal barriers, (5) fowling for Charadriidae and Scolopacidae on the peat-bog, the wet moorland or the dunes, (6) fowling for wood pigeon and Turdidae in the dunes.

The white-tailed eagle will have been caught for its wing and tail feathers, that could be used to fletch arrows. The five species of Corvidae could have been used as fowler's helps, or they could have been pets for the soldiers. No function was attributed to fish-eating and scavenging birds.

11. ACKNOWLEDGEMENTS

Many thanks are due to the participants of the A.W.N. (Archeologische Werkgemeenschap voor Nederland), department Kennemerland, working group Velsen. They carefully collected the bones

that are discussed in this paper. The warmest thanks are due to Nelie Gordijn-Vons, the intermediary between the A.W.N.-Velsen and the B.A.I. She sorted the bird bones according to skeletal element before she brought them to the B.A.I., and gave information about the way they were excavated.

A.T. Clason was my co-identifier of the bones at the B.A.I. on free evenings between 1976 and 1982. She kindly permitted me to publish our results and commented on this paper. J.N. Lanting critically read the text. J. Morel gave permission to publish figure 1. H. Reichstein, Institut für Haustierkunde, Kiel, F.R.G., gave permission to use the unpublished measurements of wild *Anser anser* in figures 6-9. I. Cornelis typed the text, R.J. Kusters made the photographs and H.R. Roelink mounted the figures.

Table 3. Velsen 1, measurements of *Anser anser*, in mm, taken after von den Driesch (1976: pp. 103-129); variables with -LOG suffix are the natural (e) logarithms of the measurements mentioned before the suffix (e.g. GL-LOG is the natural logarithm of GL, maximum length).

<i>Coracoid</i>						
GL		Lm		SC	Bb	BF
-	-	-	-	7.7	-	-
77.6	-	67.7	-	9.8	32.4	29.8
-	-	-	-	9.9	-	-
-	-	-	-	9.4	-	-
-	-	-	-	9.1	-	-
82.7	-	73.4	-	9.8	33.3	30.1
-	-	-	-	8.9	-	-
<i>Scapula</i>						
Dic						
19.3						
19.0						
17.7						
15.4						
20.3						
<i>Humerus</i>						
GL		Bp		SC	Bd	
-	-	-	-	11.0	-	-
170.0	-	35.9	-	11.3	23.8	-
-	-	40.0	-	-	-	-
-	-	-	-	11.6	24.7	-
-	-	-	-	-	25.0	-
-	-	-	-	11.4	-	-
-	-	-	-	11.6	-	-
-	-	40.3	-	-	-	-
-	-	38.2	-	-	-	-
-	-	-	-	-	20.3	-
153.2	-	33.0	-	11.4	23.2	-
-	-	-	-	-	24.3	-
-	-	-	-	-	25.6	-
-	-	-	-	11.9	24.6	-
-	-	-	-	10.1	-	-
-	-	-	-	9.2	-	-
-	-	-	-	11.9	-	-
-	-	-	-	11.9	-	-
-	-	-	-	11.9	-	-

Table 3 (cont.).

<i>Radius</i>									
GL		SC		BD		GL-LOG		BD-LOG	
-		4.9		-		-		-	
153.3		4.5		11.4		5.032		2.434	
-		5.1		-		-		-	
-		-		11.5		-		-	
-		4.7		-		-		-	
-		5.6		-		-		-	
-		4.5		10.4		-		-	
-		4.6		-		-		-	
154.1		4.7		11.4		5.038		2.434	
-		4.1		-		-		-	
-		4.6		-		-		-	
150.6		4.4		10.8		5.015		2.380	
-		5.0		11.1		-		-	
154.2		4.8		11.4		5.038		2.434	
156.5		4.6		11.7		5.053		2.460	
-		4.9		-		-		-	
<i>Ulna</i>									
GL	Dip	BP	SC	Did	GL-LOG	BP-LOG			
-	-	-	7.7	-	-	-			
158.0	-	16.2	9.0	15.6	5.063	2.785			
-	-	-	8.5	-	-	-			
-	-	-	9.0	16.8	-	-			
-	-	-	-	16.0	-	-			
-	-	-	-	16.4	-	-			
-	-	-	8.3	15.3	-	-			
-	-	-	8.6	-	-	-			
171.3	21.0	17.0	8.2	-	5.143	2.833			
<i>Carpometacarpus</i>									
GL	BP	Did							
93.5	24.6	11.2							
-	-	11.6							
-	-	9.3							
<i>Femur</i>									
Gl	LM	Bp	Dp	SC	Bd	DD	LM-LOG	DD-LOG	
79.3	76.3	19.9	14.3	7.5	19.8	15.0	4.335	2.708	
80.4	76.3	19.9	14.0	7.9	19.6	15.9	4.335	2.766	
<i>Tibiotarsus</i>									
SC	Bd	Dd							
-	17.1	17.4							
9.6	17.9	-							
8.1	-	-							
-	13.4	13.4							
7.5	-	-							
8.5	-	-							
7.8	16.5	-							
-	17.7	17.4							
8.3	-	-							
<i>Tarsometatarsus</i>									
GL	Bp	SC	BD	GL-LOG	BD-LOG				
99.1	18.8	8.4	19.8	4.512	2.986				
88.0	17.5	7.2	18.1	4.477	2.896				
-	-	-	20.2	-	-				
93.5	19.1	8.0	19.6	4.538	2.976				

12. NOTES

1. The few bird bones that are from birds that presumably died a natural death in the Oer-IJ are discussed in section 9.
2. Among the small, presumably female tarsometarsi (fig. 3) not a single one had a spur or spur scar. In Velsen 1 hens do not seem to have had spurs.

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